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1995 Feature Article - Valuing Australia's Natural Resources - Part 1

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INTRODUCTION

This is the first of two articles reporting on the ABS's work on the valuation of natural resources from the recently released national balance sheets (Occasional Paper: National Balance Sheets for Australia, Issues and Experimental Estimates 1989 to 1992, ABS cat. no. 5241.0). "Natural resources" in this context cover land, forests and subsoil deposits. The value of natural resources has not previously been included in the Australian national accounts, and these experimental estimates represent the first attempt by the ABS to value consistently a diverse range of Australia's assets.

This article discusses the issues involved in the valuation of subsoil deposits and presents the ABS's estimates based on our preferred conceptual approach. The second article will discuss the issues involved in the valuation of land and forests in Australia and will also present some results.

BACKGROUND

Over the last decade there has been a growing awareness in Australia as well as overseas of the importance of the environment and a growing demand for environmental statistics to assist research and decision-making. As part of this development, the new framework for national accounts A System of National Accounts 1993 (or SNA93)<Endnote1> recommends including natural resource assets in the national balance sheet. The work described in these articles was undertaken by the ABS in response to these changing demands.

In line with the recommendations of SNA93, the ABS has applied the principle that the valuation of an asset<Endnote2> must be related to its ability to earn its owner an income, either immediately or at some definable future date. It should be noted that natural assets may have other intangible values in addition to commercial values. However, it is not feasible to measure these in a national accounts context.

SNA93 recommends that, where possible, asset valuation should be on the basis of current, observable market prices as this is the basis on which decisions by producers, consumers, investors and other economic agents are made. However, for the most part, there are insufficient data on transactions in natural resources to support this approach. This problem is recognised by SNA93 which suggests net present value (NPV) of the future stream of income as an appropriate conceptual substitute.

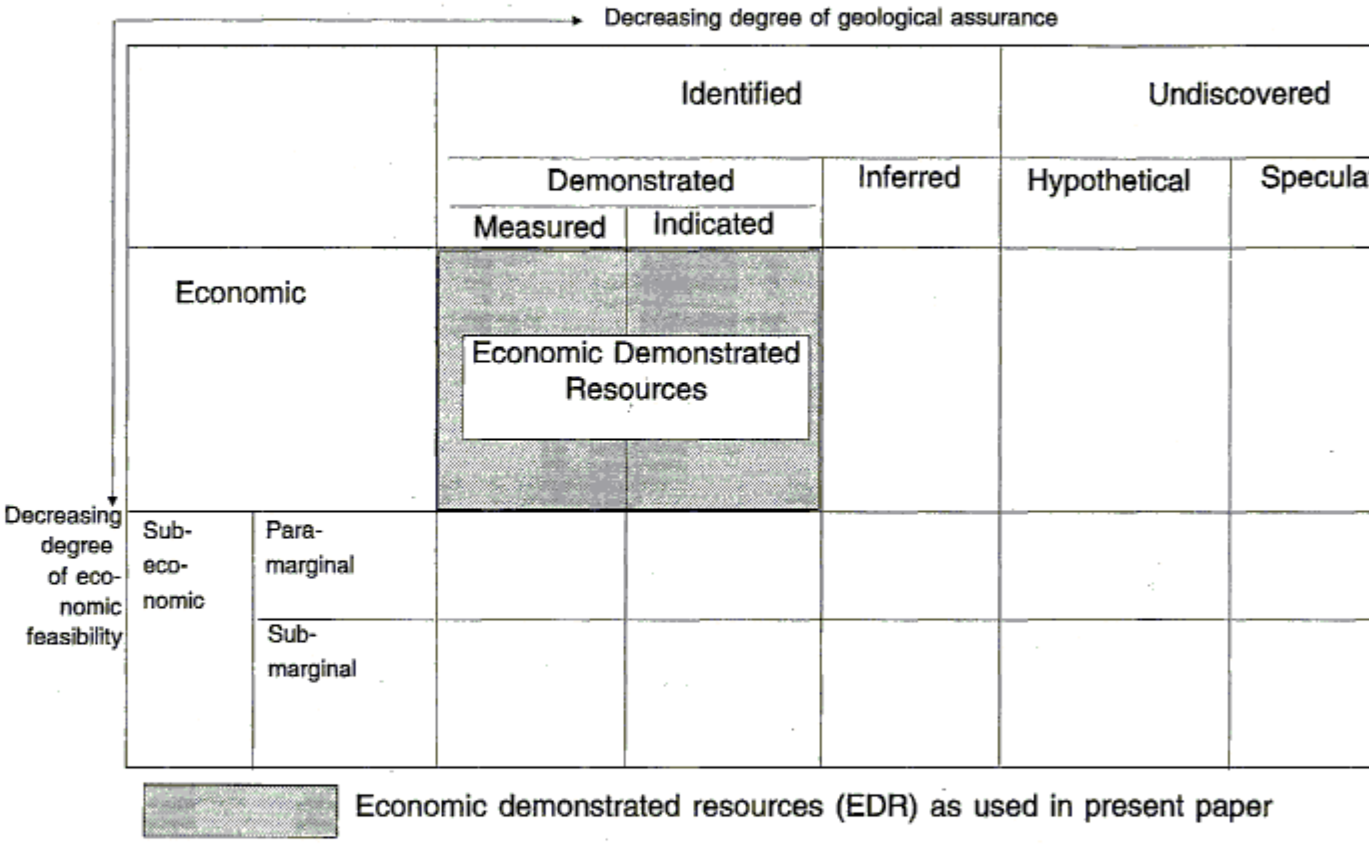
SUBSOIL ASSETS

Subsoil assets are defined in SNA93 to consist of "proven resources of mineral deposits located on or below the earth's surface that are economically exploitable given current technology and relative prices" (SNA93, para. 13.59). They include known deposits of coal, oil and natural gas resources, metallic mineral resources and non-metallic mineral resources, including deposits under the sea.

Classification of subsoil assets - the McKelvey box

Resources to be included in the national balance sheet must be in sufficient quantity and have a sufficient quality to make their extraction economic. The interaction of economics and geology is illustrated in McKelvey's Box (Figure 1) as adapted by the Bureau of Resource Sciences in Canberra (BRS). It cross-classifies subsoil assets by two characteristics. The vertical axis indicates the degree of economic feasibility and the horizontal axis indicates the degree of geological assurance of subsoil assets. The boundary between identified (discovered) and undiscovered resources may change as a result of technological improvements or a mining company's investment in exploration and development. Economic resources, which encompass economic demonstrated resources (EDR), as well as part of the inferred and undiscovered resources, are all deposits which are judged to be economically exploitable at the time of assessment (ie, they are profitable over the life of the mine). The definition of economic resources is based on the important assumption that markets exist for the commodity concerned. The BRS also assumes that producers or potential producers will operate at optimum rates of output and will receive the going market price for their products.

FIGURE 1. McKELVEY BOX AS ADAPTED BY THE BUREAU OF RESOURCE SCIENCES



Source: Bureau of Resource Sciences

Whilst the total stock of Australia's minerals is unknown it is important to note that economic demonstrated resources are a small component of the total resource stock (as shown in Figure 1). EDR is the term used by the BRS, instead of reserves, since the latter term is used by various groups to describe different resource categories. EDR refers to those resources whose geological assurance is demonstrated and for which extraction is expected to be profitable over the life of the mine. It approximates both proven and probable reserves. The ABS has chosen to value EDR rather than just proven reserves as recommended by SNA93 because:

- the data for proven reserves are not available separately from EDR; and
- measuring proven reserves only is inappropriate for a country as rich in resources as Australia.

Estimates of EDR and their values may be used for a number of purposes including setting priorities for future mineral exploration and research or assessing the need to find alternative sources of raw materials.

Valuation issues

It is difficult to value subsoil assets, as they have not yet entered the production process. SNA93 recommends that, in the absence of market transactions, the value of reserves be determined by the present value of the expected net returns resulting from the commercial exploitation of those assets, although such valuations are subject to uncertainty and revision. Similar studies in the United States and Canada have used the NPV method,<Endnote3> which makes the simplifying assumption that the present price and cost regimes will persist until the resource is exhausted.

Problems with the NPV method

SNA93 recognises that the NPV method is subject to great uncertainty and that the estimated values are subject to considerable revision. The major drawback is the uncertainty surrounding:

- the future price of the commodity;
- the technological developments which will occur during the life of the mine;
- the true size of the deposit and any nearby deposits; and
- the quantity and quality of the deposits yet to be found.

The ABS approach and data sources

The approach used by the ABS in calculating the NPV of the EDR was to take the value of gross output during a year and to deduct costs (including a "normal" return on capital) to derive net income. This was taken to be the equivalent to economic rent.<Endnote4> The stream of future net income was calculated for each year, taking into account the size of the resource at year end, average annual production and the average mine life. This future income stream was then discounted to obtain its value in today's dollars.

Most of the data for **prices** and the **volume produced** for Australia's resources are readily available from Quarterly Mineral Statistics, published by the Australian Bureau of Agricultural and Resource Economics (ABARE) (one exception was brown coal for which there is only one purchaser). The financial year-end price for the commodity for each year was used here (except in a small number of cases; for example, diamonds where the average of quarterly prices was used (see below) as there was too much volatility during the year).

Physical volume estimates of EDR in Australia are published annually by the BRS in Australia's

Identified Mineral Resources.

The estimates for **costs** were prepared by a private consultancy firm. Cost data cover labour, on-site costs, mining and milling costs and depreciation charges. In addition exploration costs within the mine lease were also included and also a normal return on capital.

The **"normal" return on capital** used was the Commonwealth government 10-year bond rate which was multiplied by the net capital stock for the mining industry (using the ABS's capital stock estimates). This figure was divided by the average extraction costs. The resulting percentage was used to mark up the extraction costs for each commodity. The 10-year bond rate was chosen as there are insufficient long-term corporate bonds in the Australian market. However, by choosing a riskless investment, the ABS has underestimated the costs of operation (including a "normal" rate of return on capital) and in consequence, overestimated the economic rent. In addition, this approach makes the assumption that the rate of return is the same for all commodities.

Mine lives were calculated by dividing the estimated EDR in each year from 1988-89 to 1991-92 by the average of the annual production in those four years.

The **discount rate** chosen should represent the cost of the risk in waiting for the cash flow from a project. Risks or uncertainties include, for example, the existence of markets, competition and natural disasters. The longer the lead time, the greater the risk that expected future cash flows will not eventuate. Other factors which must be considered in setting an appropriate discount rate include the weighted average cost of capital, future inflation and the rate of return available from alternative uses of investment funds.

The Securities Exchange Commission in New York requires that mining companies use a 10 per cent rate of discount but the ABS judged that that was too high in the present economic environment. The real discount rate preferred by the ABS is 7.5 per cent, although a 5 per cent and a 10 per cent rate were also applied as points of comparison. Interested parties are invited to comment on the choice of rate.

Discounting an uncertain future flow of income embodies a number of assumptions regarding a "steady state", that is that price, production, interest rates, operating costs and returns to capital will remain unchanged from the year the estimates are made until the resource is exhausted. These assumptions are clearly unrealistic. Moreover, the resource life is unknown until the subsoil asset is fully extracted. However, these assumptions were considered to be more appropriate than attempting to forecast factors such as prices and interest rates well into the future.

Other methods of monetary valuation for the value of subsoil assets examined by the ABS were the net price method<Endnote5> and the user (or replacement) cost method<Endnote6> but both were considered to be inappropriate.

Results

Total subsoil values are shown in Table 1 using the NPV method. At 30 June 1992, the value of Australia's economic demonstrated subsoil assets, using the NPV approach and a discount rate of 7.5 per cent, was estimated to be $145.2 billion. This figure represents 22 per cent of the estimated value of Australia's non-produced assets, 7.8 per cent of Australia's non-financial assets, 7.3 per cent of Australia's total assets, and 8.7 per cent of Australia's estimated net worth at 30 June 1992. Further, over the three years from 30 June 1989 to 30 June 1992, the relative importance of subsoil assets as a percentage of net worth grew by 24 per cent. While these values may seem to be low in view of the perception of the role of minerals for the Australian economy, the mining industry's importance can be better demonstrated by its impact on the

balance of payments (23 per cent of gross merchandise exports in 1993-94). Moreover, in the discussion below ("Interpretation of the estimates"), the issue of resource size is explored.

TABLE 1 TOTAL VALUE OF AUSTRALIA'S ECONOMIC DEMONSTRATED RESOURCES, USING YEAR END PRICES, AS AT 30 JUNE, 1989-1992, (BILLION)

		Rate of discount		
	0 per cent	5 per cent	7.5 per cent	10 per cent
1989	841	156	109	84
1990	842	163	116	90
1991	958	190	136	106
1992	891	199	145	115

Appendix 1 shows the size and value of the current estimates of EDR of the 33 major mineral commodities in Australia, associated with mineral fields which have been discovered to the end of December for each year. The results suggest that at 30 June 1992, bauxite ($36.6 billion), gems ($27.2 billion), iron ore ($27.2 billion), crude oil ($12.8 billion) and natural gas ($10.7 billion) had the highest value of the major commodities in Australia. While the value of these commodities may be high relative to other commodities, it should be remembered that some of the other commodities make major contributions to our export income, for example, gold ($4.0 billion) and mineral sands ($0.7 billion).

Further, the NPV estimates are subject to considerable variability from one year to the next, due to factors such as changes in price or changes in the costs of extraction. As an example, the NPV of black coal was estimated to be negative from 30 June 1989 to 30 June 1991 (but shown as zero in the table) but by 30 June 1992 black coal was estimated to have a value of $1.9 billion. The turnaround in value was mainly the result of a reduction in extraction costs.

Minerals not included in Appendix 1 are those for which no EDR information is available either because the EDR for the minerals are unknown or because the demonstrated resources of minerals are in almost infinite supply (for example, clay and sand) and hence are not measured.

Interpretation of the estimates

Given the way estimates of the value of subsoil assets are derived, only a very small portion of the total resource is accounted for at any one time; and valuation can give a very misleading impression of the extent of the resource. The argument here is not that valuation should not be attempted but rather that the monetary valuation should be used in conjunction with the physical stocks of the resources. The volatility of the estimates of the value of EDR, as shown in Table 1, could be due to one or more of the following factors:

- Mineral prices can fluctuate considerably over a year.
- The quantities of EDR may have changed because of the technological developments.
- The quantities of EDR may have changed due to conceptual or classification changes in the compilation of the estimates by the BRS.
- Some resources which had been previously sub-economic might have become economic (or vice versa) due to price fluctuations.
- The choice of discount rate has a considerable impact on the estimates.

As shown in Appendix 1, many resources in Australia have very long potential lives at present production levels and present price and cost regimes (for example, bauxite 125 years, black coal

over 300 years) mainly because the reserves that have been identified are close to the surface and have not entailed great expense to find. However, for crude oil and gold, the lives average only 10 years, while copper is a steady 21 years, reflecting the far greater cost of finding and proving these resources and the concomitant disinclination of firms to tie up capital. However, the exact size of the economic resource is known only when the well or mine has ceased to produce.

Hence, both the monetary and physical estimates must be viewed with some caution. Monetary estimates are subject to considerable volatility and accordingly can give a deceptively optimistic or pessimistic picture. Physical estimates may offer a very limited view of the resource's full extent. For countries such as Australia, where there are potentially vast resources undiscovered, the physical estimates should be seen more as an indicator than as a definitive statement. Nevertheless, the physical volumes of the resource are at least as useful (in terms of analysis of the resource and the country's overall financial position) as the monetary values. They show that, provided there remain reasonable lives, there should be no undue concern about exhaustion. The "stock" (i.e., the physical resource in the ground on which the valuation on the balance sheet is based) can be expected to remain reasonably close to constant, provided that:

- the ore body is not being exhausted, prices have not fallen sufficiently to render the ore body uneconomic or risen so much as to prompt accelerated production, and
- discovery remains broadly in line with the usage of the resource.

While the physical level of the resource remains fairly constant, it may be interpreted as implying that some sort of "sustainability" is possible. But this concept should not be taken too far because there may be other reasons beside exhaustion of the reserve that could result in a drop in the resource. Changes in the demand for the resource may be caused by changing technology or environmental concerns. Coal, for example, may be regarded as limitless to all intents and purposes but for many countries, coal reserves (as an economic resource) may be disappearing as fast as oil, gas and electricity have replaced it and environmental concerns may have raised the costs of the externalities.

Meanwhile, although monetary valuations will reflect certain economic realities, such as the on-going viability of the resources over the foreseeable future, taking current prices and extraction costs into account, there must be a recognition of the limitations that are embodied in those estimates (such as on prices and interest rates). Valuation of natural resources is still very much in its infancy and interpretation of the results should be made in that context.

CONCLUSION

This article has discussed the conceptual issues related to the valuation of subsoil assets, including the approach taken by the ABS. Subsoil assets represent a significant part of Australia's assets and export earnings. However, interpretation of the results should be undertaken with care as there are still many conceptual and data issues to be resolved. Readers are invited to provide comment by writing to: Director, National Accounts Research Section, ABS, PO Box 10, Belconnen, ACT 2616.

The second article in this series will discuss critically the methodologies and data sources used in the calculation of the ABS's estimates of the value of land and forests in Australia.

Endnotes

1. The SNA is being widely adopted by government statistical agencies throughout the world, including the ABS, as the conceptual basis for compiling their national accounts.<back>
2. For an asset to be included in the national balance sheets, SNA93 states that it must fulfil

certain criteria:

- it must be an "economic asset" over which ownership rights are enforced by institutional units, individually or collectively;
- it must be an "economic asset" from which economic benefits may be derived by its owner by holding it, or using it, over a period of time. The economic benefits consist of income derived from the use of the asset and the value, including possible holding gains/losses, that could be realised by disposing of the asset or in the case of a financial asset, by extinguishing it.<back>

3. The net present value approach: <back>

The relationship between prices, costs and rates of return is shown by the following formula for the present discounted value of EDR:

$$PV_0 = \sum_{t=1}^{T} \left(N_t * q_t / (1 + r)^t \right)$$

Where PV_0 represents the present value of the EDR;

N_t is the net price per unit allowing for financial (e.g. capital costs and depreciation) and operating costs over period t, where these extraction costs also include a normal return on capital;

q_t is the quantity of EDR produced over period t;

r is the discount rate; and

T is the expected mine life.

$$PV0 = \sum_{t=1}^{T} N_t * q_t$$

Therefore represents the future income flow generated over the expected life of the asset. Note that by summing from t = 1, the income flow is discounted in the first year.

4. Economic rent is return to the owner of the resource for use of that resource but excludes the costs necessary to replace it. Originally applied to land, it is now generally applied as the return to the owners of any natural resource.<back>

5. The net price method (in relation to subsoil valuation as defined by Landefeld and Hines (1985)), involves calculating the total revenue from extraction, less extraction cost (which should be taken to include a return to produced capital) and dividing this difference by the total quantity extracted in period t. The net price per unit is multiplied by the quantity of remaining resources to obtain a net value. The ABS found estimates derived using the net price approach were inappropriate for valuing future production and they have not been used in the balance sheets. The net price approach results in very high values for subsoil assets, which suggests that the value of future production is being overstated. Although the net price approach has the attraction of simplicity it is the ABS's view that it is unsatisfactory for valuing subsoil assets. In practice, it is not possible to mine all the resource in one year and even if it were possible, the prices for many

commodities would be affected by the large supply. In addition, implicit in the net price approach is the assumption that the net economic value of the resource rises each year in line with the rate of interest. There is little evidence to support this assumption.<back>

6. The user cost approach attempts to split the revenue, net of extraction costs, from the sales of a depletable subsoil asset into a capital element (or user cost) and a value added element representing "true income". The capital element represents asset erosion which could be reinvested to generate sufficient future income to maintain the present level of "true income" as the subsoil asset is being depleted and long after the original subsoil asset has been exhausted.<back>

The concept behind the user cost approach is to calculate that part of total receipts attributable to "true income". In practice, a discount rate is applied to the total receipts over the whole life of the resource. This involves calculating the amount of income which would have to be reinvested in each period to maintain the same income in each period while the resource is being used and after it is exhausted. Assumptions have to be made about the life expectancy of the subsoil asset measured in years and the discount rate. The main drawback with the user cost approach is that it does not incorporate unrealised capital gains and losses due to price changes, which is part of the income (See El Serafy 1989).

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Glossary of terms in the McKelvey Box

Identified resources - specific bodies of mineral-bearing material whose location, quantity and quality are known from specific measurement or estimated from geological evidence. Identified resources include economic and sub-economic components.

Measured resources - for which tonnage is computed from dimensions revealed in outcrops, trenches, working and drill holes and for which the grade is computed from the results of detailed sampling. The sites for inspection, sampling and measurement are spaced so closely and the geological character is so well defined, that size, shape and mineral content are well established.

Indicated resources - for which tonnage and grade are computed from information similar to that used for measured resources but the sites for inspection, sampling and measurement are more widespread. The degree of assurance, although lower than for resources in the measured category, is high enough to assume continuity between points of observation.

Demonstrated resources - a collective term for the sum of measured and indicated resources.

Inferred resources - resources for which quantitative estimates are based largely on broad knowledge of the geological character of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition, of which there is geological evidence. This evidence may include comparisons with deposits of similar type. Bodies that are completely concealed may be included if there is specific geological evidence of their presence.

Economic feasibility - implies that, at the time of determination, profitable extraction or production under defined investment assumptions has been established, analytically demonstrated or assumed with reasonable certainty.

Sub-economic resources - those resources that do not meet the criteria of economic feasibility.

Para-marginal - sub-economic resources that, at the time of determination, almost satisfy the criteria of economic feasibility. Included are resources that would be able to be produced given postulated changes in economic or technological factors.

Sub-marginal - sub-economic resources that would require a substantially higher commodity price or some major cost-reducing advance in technology to render them economic.

To the right of the EDR in Figure 1 are undiscovered resources which consist of inferred, hypothetical and speculative resources. These are economic resources which have not been found. For many subsoil assets their size is almost certainly larger than the EDR.

APPENDIX 1. VALUE OF AUSTRALIA'S DEMONSTRATED MINERAL RESOURCES, BY COMMODITY, AS AT 30 JUNE EACH YEAR

	Economic demonstrated resources	Price 30 June $/unit	Costs Including normal return on capital	Production	Mine life (years)	Rate of discount 5 per cent	7.5 per cent	10 per cent
Antimony						$M	$M	$M
	Kilo-tonne	Tonne	Tonne	Kilo-tonne				
1989	15.2	1,607	38	1.83	9	32	26	22
1990	14.5	1,500	35	1.35	9	30	25	21
1991	39.5	1,193	33	1.56	24	24	20	16
1992	63.5	773	30	1.84	39	15	13	10
Average production/mine life				1.64	20.19			
Bauxite								
	Giga-tonne	Tonne	Tonne	Giga-tonne				
1989	5.5	130	26	0.04	140	83,063	55,492	41,624
1990	5.6	107	24	0.04	142	66,225	44,243	33.186
1991	6.4	125	23	0.04	160	80,716	53,924	40,448
1992	2.4	95	26	0.04	60	54,715	36,553	27,418

Average production/mine life				0.04	125.22			
Black coal- recoverable								
	Giga-tonne	Tonne	Tonne	Giga-tonne				
1989	50.8	51	62	0.15	311	-	-	-
1990	51.1	58	64	0.16	313	-	-	-
1991	51.4	57	61	0.17	315	-	-	-
1992	52.0	56	55	0.18	31.9	2,912	1,941	1,456
Average production/mine life				0.16	314.42			
Brown coal - recoverable (a)								
	Giga-tonne	Tonne	Tonne	Giga-tonne				
1989	41.8	na	na	0.05	857	-	-	-
1990	41.7	na	na	0.05	855	-	-	-
1991	41.7	na	na	0.05	855	-	-	-
1992	41.0	na	na	0.05	841	-	-	-
Average production/mine life				0.05	852.31			
Cadmium								
	Kilo-tonne	Tonne	Tonne	Kilo-tonne				
1989	58.4	11,192	451	1.97	26	340	268	217
1990	55.7	13,554	417	2.29	25	416	328	266
1991	63.3	6,336	432	2.62	29	187	147	120
1992	50.2	3,289	478	1.99	23	89	70	57
Average production/mine life				2.22	25.68			
Cobalt								
	Kilo-tonne	Tonne	Tonne	Kilo-tonne				
1989	18.0	37,610	59,695	2.27	10	-	-	-
1990	85.0	45,503	55,158	1.86	49	-	-	-
1991	80.0	65,273	51,652	1.41	46	381	287	226
1992	53.0	67,536	44,984	1.35	31	631	474	374
Average production/mine life				1.72	34.26			
Copper								
	Mega-tonne	Tonne	Tonne	Mega-tonne				
1989	6.5	3,780	2,845	0.28	21	3,777	3,062	2,540
1990	6.7	3,626	2,629	0.31	21	4,029	3,266	2,709
1991	6.9	3,197	2,245	0.33	22	3,847	3,119	2,587
1992	6.5	3,062	2,124	0.34	21	3,789	3,072	2,548
Average production/mine life				0.31	21.25			
Diamond-Gem								
	Million carats	Carat	Carat	Million carats				
1989	179.0	57	68	15.61	12	-	-	-
1990	380.0	93	69	15.35	25	5,135	4,085	3,340
1991	569.0	78	68	13.22	37	2,111	1,679	1,373
1992	366.0	219	60	17.81	24	34,210	27	22,251
Average production/mine life				15.50	24.10			
Diamond-Industrial								
	Million carats	Carat	Carat	Million carats				
1989	214.0	5	4	20.69	11	348	276	226
1990	487.0	5	4	15.40	25	487	387	316
1991	712.0	8	3	17.53	37	1,227	975	797
1992	458.0	24	5	23.61	24	5,629	4,474	3,656
Average production/mine life				19.31	24.23			
Garnet								
	Mega-tonne	Tonne	Tonne	Mega-tonne				
1989	9	94	45	0.03	322	27	18	14
1990	9	94	42	0.03	322	29	19	15
1991	11	94	39	0.02	393	31	21	15
1992	11	94	36	0.04	393	33	22	16
Average production/mine life				0.03	357.24			
Gold								
	Tonne	Kilogram	Kilogram	Tonne				
1989	1,486.0	17,373	11,896	185.37	7	8,851	7,926	7,142
1990	2,129.0	17,114	12,357	224.10	10	7,687	6,884	6,203
1991	2,145.0	16,749	13,304	240.77	10	5,567	4,985	4,492

1992	2,466.0	16,046	13,274	241.47	11	4,478	4,010	3,613
Average production/mine life				222.93	9.23			
Iron ore								
	Giga-tonne	Tonne	Tonne	Giga-tonne				
1989	14.3	21	7	0.10	132	30,174	20,129	15,097
1990	14.7	25	6	0.11	136	41,040	27,378	20,534
1991	17.9	27	7	0.11	165	42,273	28,201	21,151
1992	17.9	26	7	0.12	165	40,823	27,233	20,425
Average production/mine life				0.11	149.58			
Lead								
	Mega-tonne	Tonne	Tonne	Mega-tonne				
1989	11.5	832	1,013	0.49	21	-	-	-
1990	10.7	1,054	945	0.52	20	710	584	490
1991	10	972	795	0.56	19	1,149	945	793
1992	8.9	760	750	0.57	17	67	55	46
Average production/mine life				0.54	19.21			
Lithium								
	Kilo-tonne	Tonne	Tonne	Kilo-tonne				
1989	359.1	4,614	337	32.81	9	766	715	670
1990	150.0	4,950	340	47.43	4	826	771	722
1991	160.0	5,264	320	40.38	4	886	827	774
1992	160.0	5,578	278	42.52	4	949	886	830
Average production/mine life				40.78	5.08			
Magnesite								
	Mega-tonne	Tonne	Tonne	Mega-tonne				
1989	7.0	44	51	0.20	35	-	-	-
1990	7.0	39	47	0.20	35	-	-	-
1991	7.0	42	45	0.20	35	-	-	-
1992	7.0	45	39	0.20	35	19	14	11
Average production/mine life				0.20	35.00			
Maganese ore								
	Mega-tonne	Tonne	Tonne	Mega-tonne				
1989	118.0	84	7	1.92	66	2,612	1,807	1,367
1990	111.0	140	6	2.29	62	4,553	3,151	2,383
1991	110.0	206	6	1.62	62	6,777	4,689	3,546
1992	108.0	210	6	1.31	61	6,928	4,794	3,625
Average production/mine life				1.78	62.72			
Mineral sands-Ilimenite								
	Mega-tonne	Tonne	Tonne	Mega-tonne				
1989	64.2	75	50	1.69	40	749	525	399
1990	80.7	83	47	1.65	50	1,076	754	573
1991	102.4	85	57	1.48	64	829	581	441
1992	111.8	80	50	1.59	70	900	631	479
Average production/mine life				1.60	55.98			
Mineral sands-Rutile								
	Mega-tonne	Tonne	Tonne	Mega-tonne				
1989	9.4	667	415	0.25	43	1,024	723	551
1990	11.6	768	383	0.24	53	1,563	1,104	841
1991	11.7	732	631	0.22	53	411	290	221
1992	13.5	579	549	0.18	61	123	87	66
Average production/mine life				0.22	52.50			
Mineral sands - Zircon								
	Mega-tonne	Tonne	Tonne	Mega-tonne				
1989	15.2	536	392	0.51	37	1,045	755	581
1990	18.0	658	362	0.48	44	2,143	1,548	1,192
1991	19.3	517	429	0.34	47	634	458	353
1992	20.3	319	347	0.31	50	-	-	-
Average production/mine life				0.41	44.55			
Nickel								

	Mega-tonne	Tonne	Tonne	Mega-tonne				
1989	1.1	18,119	13,730	0.06	17	4,889	3,604	2,805
1990	3.0	12,468	12,686	0.07	46	-	-	-
1991	3.4	11,155	11,889	0.07	52	-	-	-
1992	2.7	9,891	10,354	0.06	41	-	-	-
Average production/mine life				0.07	38.93			
Petroleum (recoverable) - Crude Oil								
	Giga-litre	Kilolitre	Kilolitre	Giga-litre				
1989	260	120	144	25.57	9	-	-	-
1990	264	147	133	28.74	10	2,974	2,653	2,382
1991	285	203	123	28.66	10	16,569	14,780	13,271
1992	258	181	112	27.78	9	14,359	12,809	11,501
Average production/mine life				27.69	9.63			
Petroleum - Natural Gas								
	Billion m^3	'000 m^3	'000 m^3	Billion m^3				
1989	953	50	31	15.77	48	6,796	4,924	3,798
1990	853	59	29	20.08	43	10,622	7,697	5,937
1991	691	65	26	20.74	35	13,724	9,945	7,670
1992	950	65	23	22.56	48	14,773	10,705	8,256
Average production/mine life				19.79	43.55			
Petroleum - Condensate								
	Giga-litre	Kilolitre	Kilolitre	Giga-litre				
1989	114	120	144	2.68	36	-	-	-
1990	78	147	133	3.25	24	740	557	439
1991	118	203	123	3.29	37	4,120	3,102	2,444
1992	124	181	112	3.53	39	3,571	2,388	2,118
Average production/mine life				3.19	34.03			
LPG naturally occurring								
	Giga-litre	'000 m^3	'000 m^3	Giga-litre				
1989	119	74	32	3.76	32	2,485	1,880	1,485
1990	106	76	30	3.79	29	2,717	2,056	1,625
1991	129	116	27	3.55	35	5,240	3,964	3,133
1992	131	109	24	3.59	36	5,007	3,788	2,993
Average production/mine life				3.67	33.03			
Platinum group (T,PT,PD)								
	Tonne	Kilogram	Kilogram	Tonne				
1989	na	22,254	12,932	0.07	na	-	-	-
1990	22.8	21,443	12,760	0.07	260	15	10	8
1991	19.0	16,948	11,956	0.09	217	9	6	4
1992	17.0	17,508	10,413	0.13	194	12	8	6
Average production/mine life				0.09	167.52			
Rare earths (REO, Y203)								
	Kilo-tonne	Tonne	Tonne	Kilo-tonne				
1989	360.0	854	79	10.39	38	117	89	70
1990	300.0	933	73	13.43	32	130	98	78
1991	300.0	300	68	3.83	32	35	27	21
1992	300.0	300	60	7.04	32	36	28	22
Average production/mine life				9.42	33.43			
Silver								
	Kilo-tonne	Kilogram	Kilogram	Kilo-tonne				
1989	21.8	234	119	1.09	19	1,489	1,244	1,057
1990	20.7	217	110	1.10	18	1,386	1,158	984
1991	19.2	180	99	1.14	17	1,055	882	749
1992	17.0	181	90	1.25	15	1,177	984	836
Average production/mine life				1.15	17.18			
Talc								
	Mega-tonne	Tonne	Tonne	Mega-tonne				
1989	5.0	60	73	0.21	25	-	-	-
1990	7.0	62	76	0.23	35	-	-	-
1991	9.0	65	74	0.17	45	-	-	-
1992	11.0	70	71	0.18	55	-	-	-
Average production/mine life				0.20	40.16			
Tantalum								

	Kilo-tonne	Kilogram	Kilogram	Kilo-tonne				
1989	11.4	76	64	0.44	19	74	63	55
1990	11.4	86	64	0.44	19	132	113	98
1991	6.0	98	60	0.70	10	227	194	168
1992	5.9	116	53	0.87	10	388	332	288
Average production/mine life				0.61	14.14			
Tin								
	Kilo-tonne	Tonne	Tonne	Kilo-tonne				
1989	191.4	15,822	11,690	7.19	28	372	300	247
1990	143.2	11,624	10,802	8.19	21	74	60	49
1991	165.5	9,320	10,121	5.67	24	-	-	-
1992	99.7	10,207	8,816	6.21	15	125	101	83
Average production/mine life				6.81	22.12			
Tungsten ore								
	Kilo-tonne	Tonne	Tonne	Kilo-tonne				
1989	18.5	48	83	1.39	21	-	-	-
1990	5.4	45	79	1.21	6	-	-	-
1991	5.1	43	74	0.69	6	-	-	-
1992	1.1	38	65	0.16	1	-	-	-
Average production/mine life				0.86	8.70			
Uranium								
	Kilo-tonne	Kilogram	Kilogram	Kilo-tonne				
1989	474.0	79	49	4.51	109	2,604	1,744	1,309
1990	469.0	70	45	4.09	108	2,187	1,465	1,099
1991	474.0	54	41	4.39	109	1,080	723	543
1992	462.0	52	36	4.35	107	1,406	941	706
Average production/mine life				4.33	108.41			
Zinc								
	Mega-tonne	Tonne	Tonne	Mega-tonne				
1989	20.4	2,340	1,959	0.77	22	4,233	3,483	2,922
1990	17.9	2,378	1,810	0.87	20	6,311	5,193	4,357
1991	16.9	1,656	1,574	1.00	18	914	752	631
1992	15.0	1,837	1,702	1.02	16	1,504	1,238	1,039
Average production/mine life				0.91	19.19			

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